



Probe of Extreme Multi-Messenger Astrophysics (POEMMA) Probe Mission

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NASA Probe Studies for 2020 Decadal Survey



- NASA funding 10 Probe Class (below 1B\$) Mission (18 mos) Studies in Preparation for the 2020 Decadal Survey - POEMMA: Probe of Extreme Multi-Messenger Astrophysics
- PI responsible for the final report (due NLT Dec 2018)
- NASA will submit these studies to the Decadal Survey
- Decadal Survey Committee will have the option to prioritize any of these mission concepts, or recommend a competed line of Probes (similar to Explorers)
- Selection based on Science Merit (cost, schedule)

PI	Affiliation	Short title	Design Lab/Prog Office
Camp, J.	NASA's GSFC	Transient Astrophysics Probe	IDC/PCOS-COR
Cooray, A.	Univ. California, Irvine	Cosmic Dawn Intensity Mapper	TeamX/ExEP
Danchi, W.	GSFC	Cosmic Evolution through UV spectroscopy	IDC/PCOS-COR
Glenn, J.	Univ. of Colorado	Galaxy Evolution Probe	TeamX/ExEP
Hanany, S.	Univ. of Minnesota	Inflation Probe Mission Concept Study	TeamX/ExEP
Mushotzky, R.	Univ. of Maryland	High Spatial Resolution X-ray Probe	IDC/PCOS-COR
Olinto, A.	Univ. of Chicago	Multi-Messenger Astrophysics	IDC/PCOS-COR
Plavchan, P.	Missouri State Univ.	Precise Radial Velocity Observatory	No design lab funded/HQ grant
Ray, P.	Naval Research Lab	X-ray Timing and Spectroscopy	IDC/PCOS-COR
Seager, S.	MIT	Starshade Rendezvous	TeamX/ExEP



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THE

11

Greatest Unanswered Questions of Physics

No. 9
What Is Gravity?

POEMMA

-

- Ground Array stations



Starting Point Design

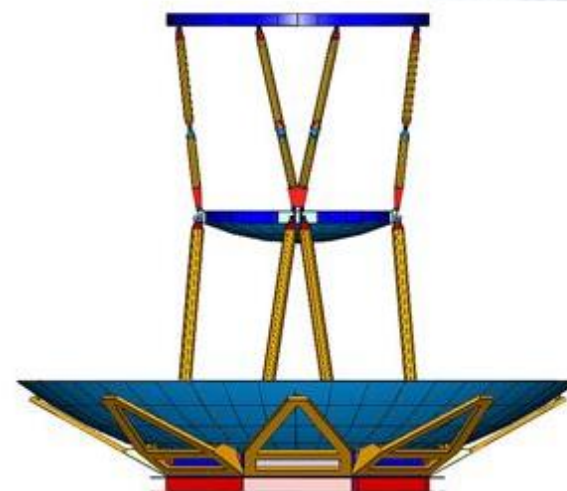
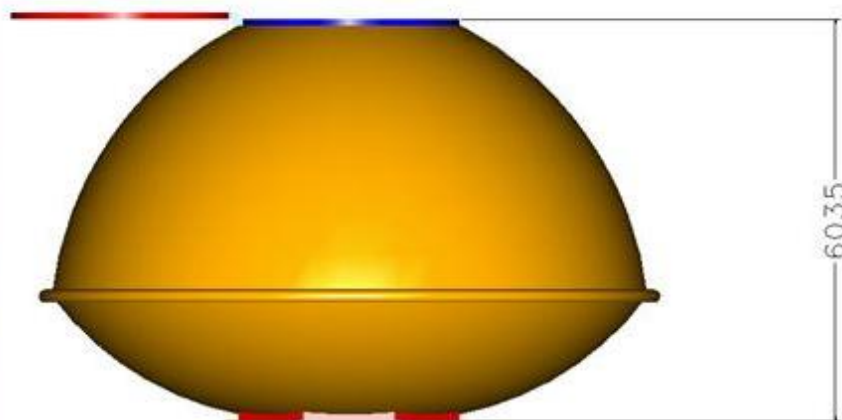


- 2 formation-flying spacecraft (OWL concept)
- f/1 Schmidt camera, 45° FoV,
- Detailed design being defined – OWL scaling:
- 10 m diam. primary mirror deployable (OWL: 7m)
- 4.3 m diam. corrector lens
- 8 m² focal plane with ~500,000 pixels
- (~ 0.06° pixel ~1 km² projected on the ground at 1,000km altitude)
- 14 m² effective aperture (OWL: 7.07 m²)
- weight TBD ~2400 kg;
- power consumption TBD ~600 W

CAD Views of OWL

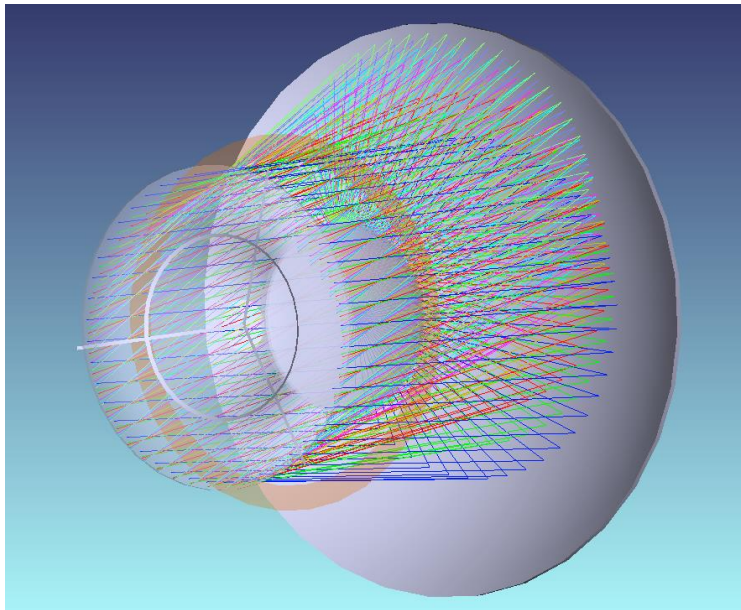
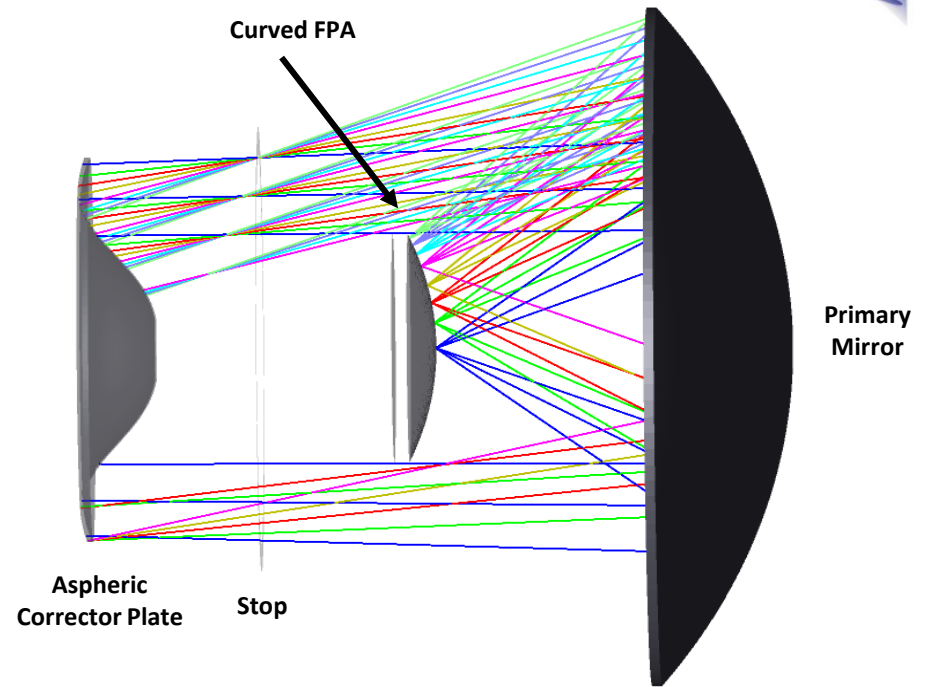
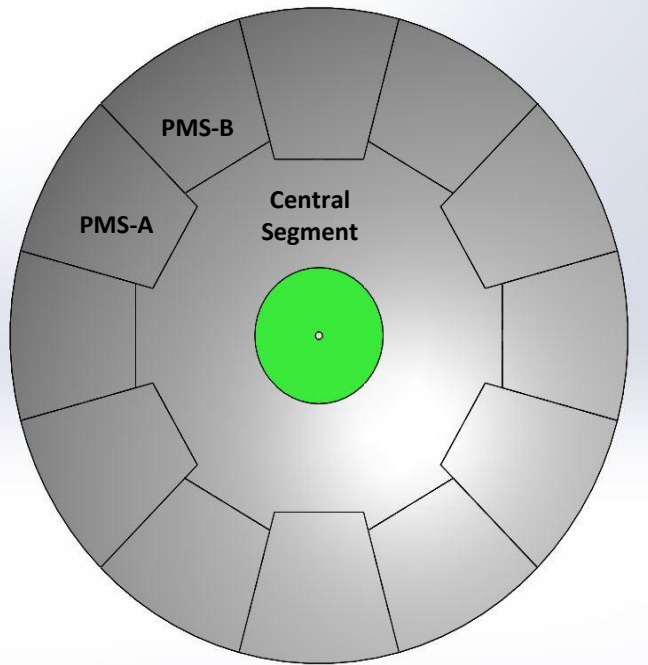
Instrument Synthesis and Analysis Laboratory

OWL - Orbiting Wide-Angle Light Collectors
IDL Study - 2001





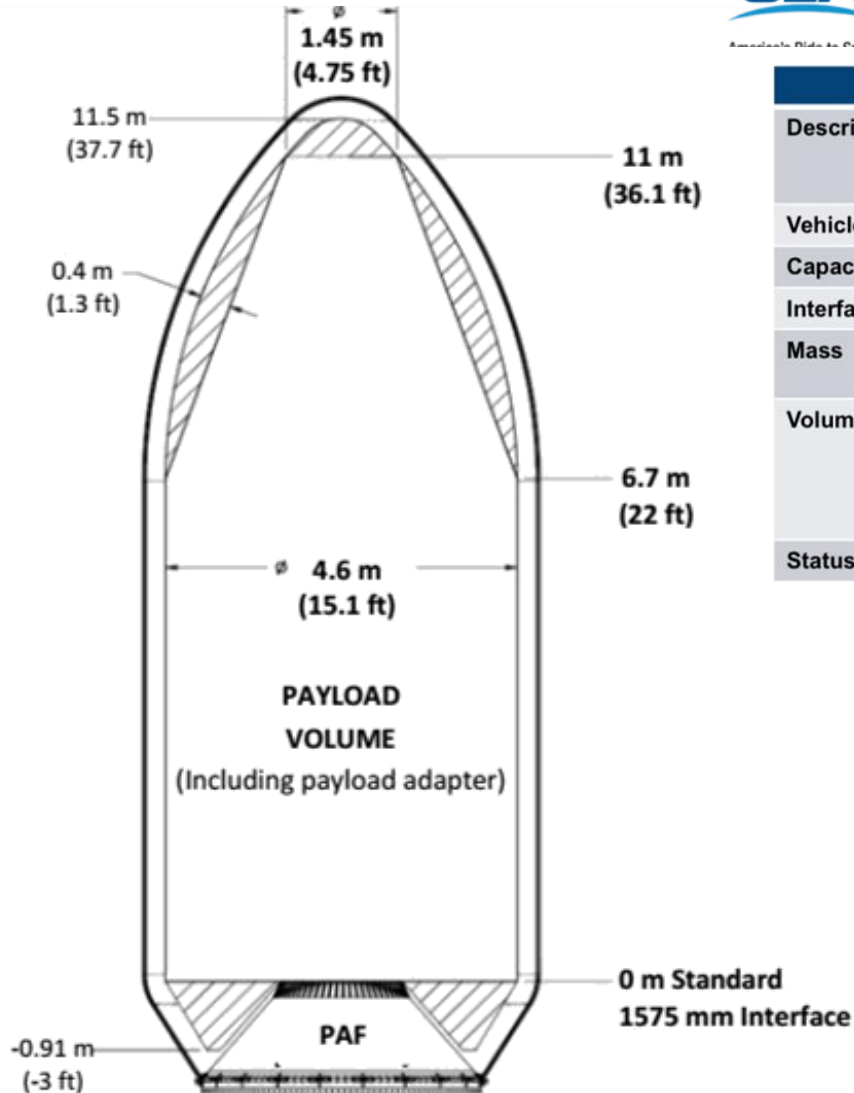
POEMMA Optical Layout



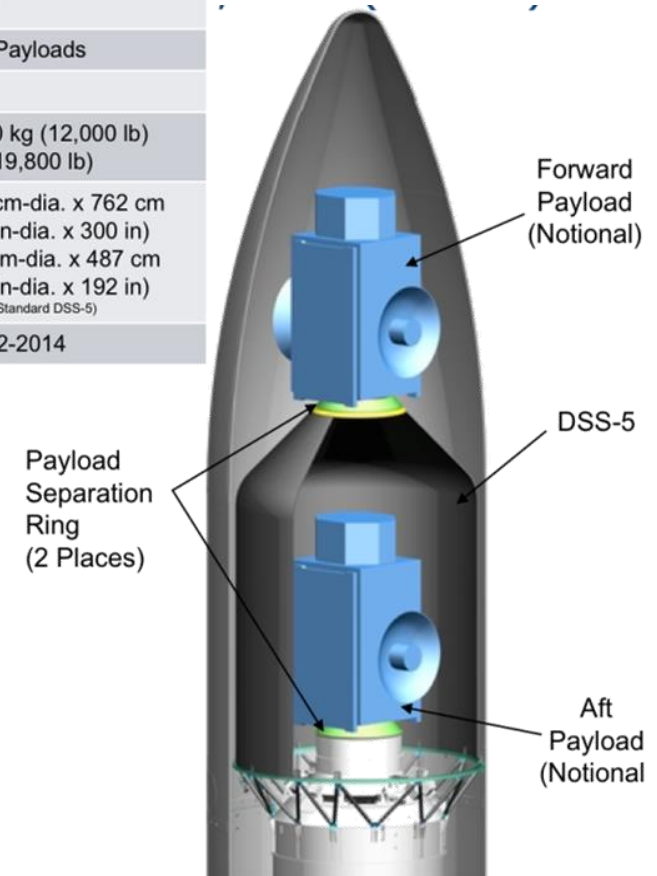
SpaceX Fairing



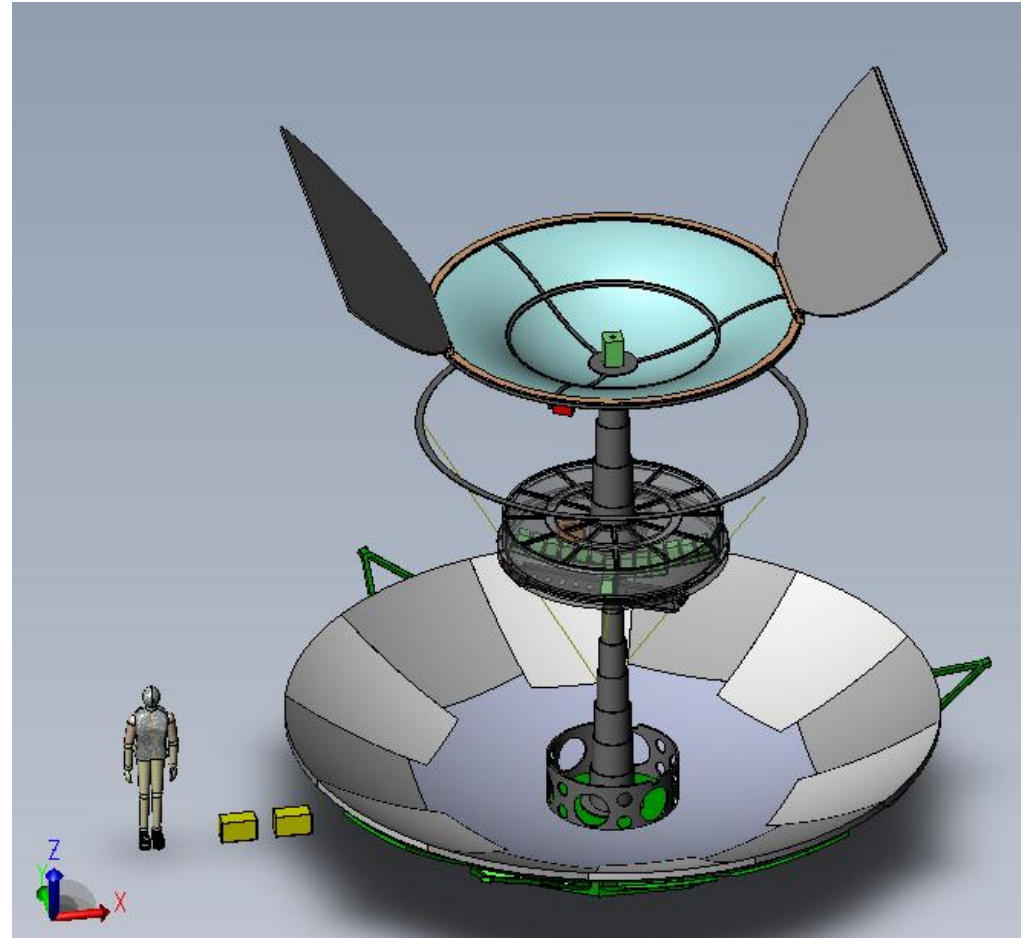
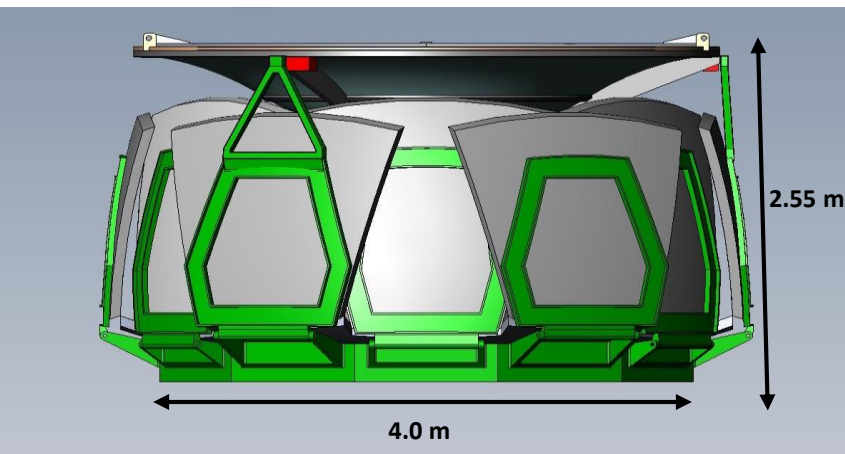
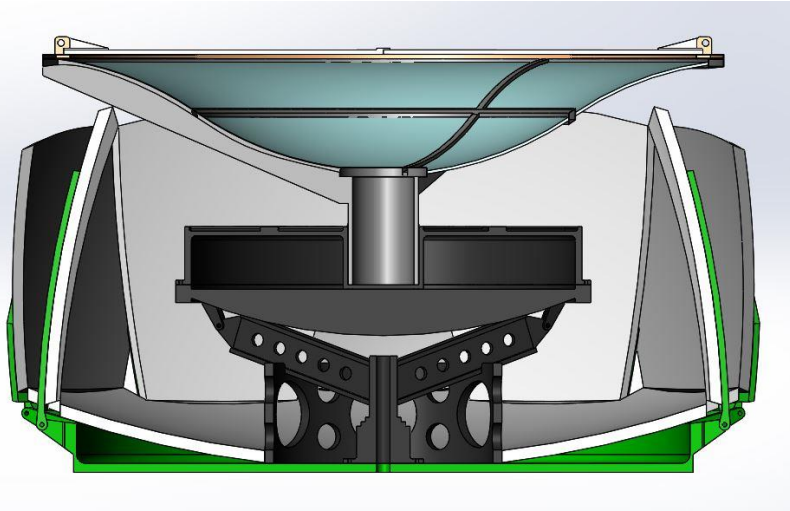
Dual Spacecraft System, 5-m (DSS-5)



DSS-5	
Description	A Dual-manifest Launch Capability for 5-m Fairings, Using Newly Designed Composite Structure
Vehicle	Atlas V, Delta IV, Vulcan
Capacity	1 DSS-5 per Launch, 2 Payloads
Interface	62-in Bolted
Mass	Forward Payload: 5,440 kg (12,000 lb) Aft Payload: 9,000 kg (19,800 lb)
Volume	Forward Payload: 457-cm-dia. x 762 cm (180-in-dia. x 300 in) Aft Payload: 375-cm-dia. x 487 cm (148-in-dia. x 192 in) (Standard DSS-5)
Status	In Development; CDR 12-2014

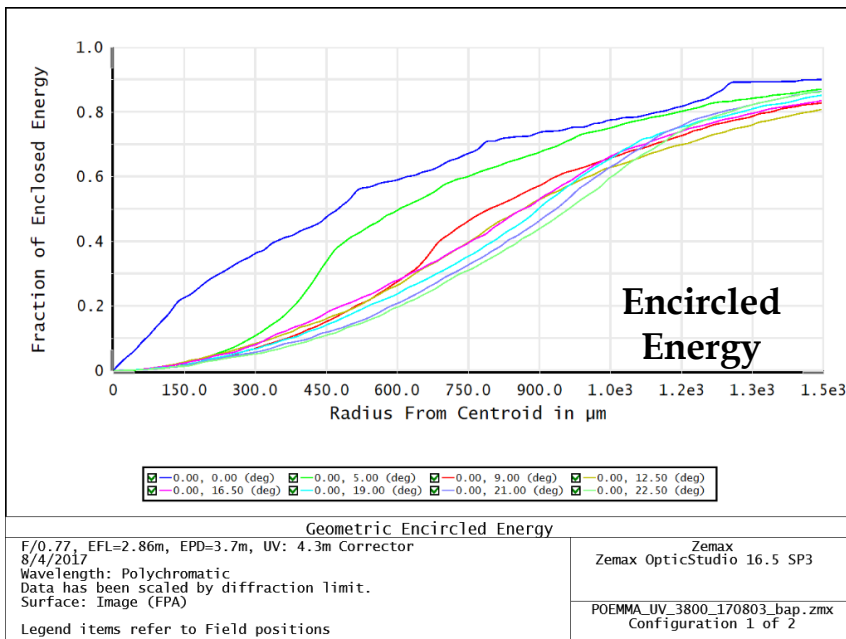
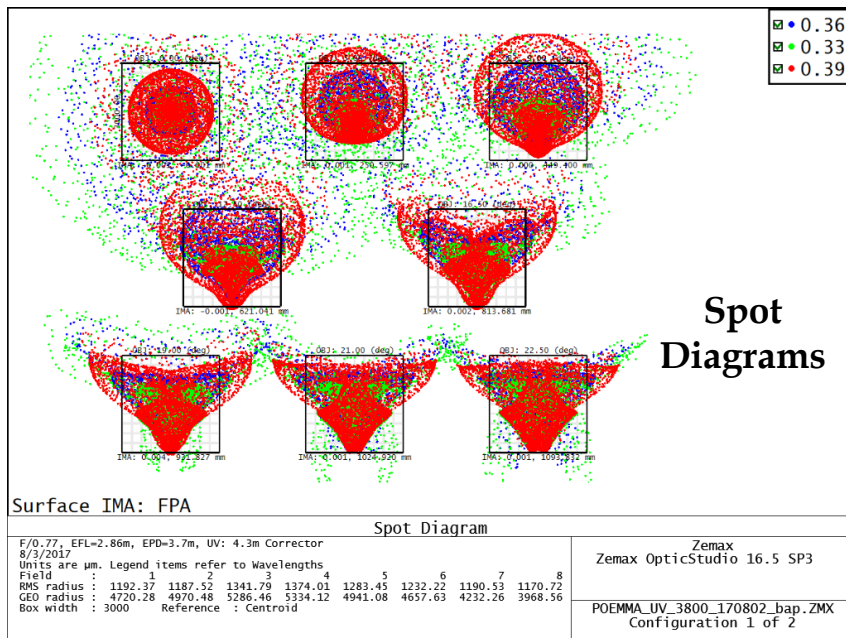


IDL Mechanical Design

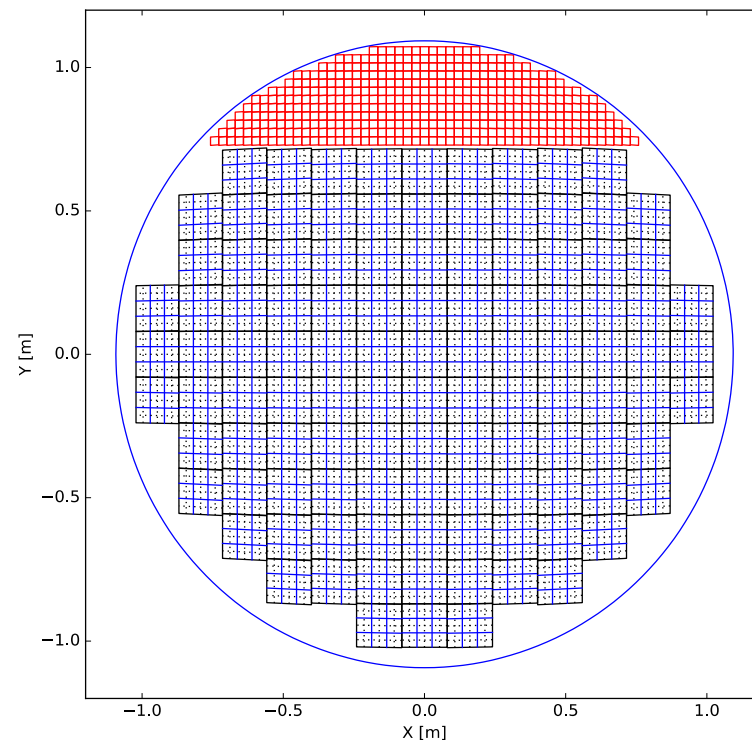




Optical Performance

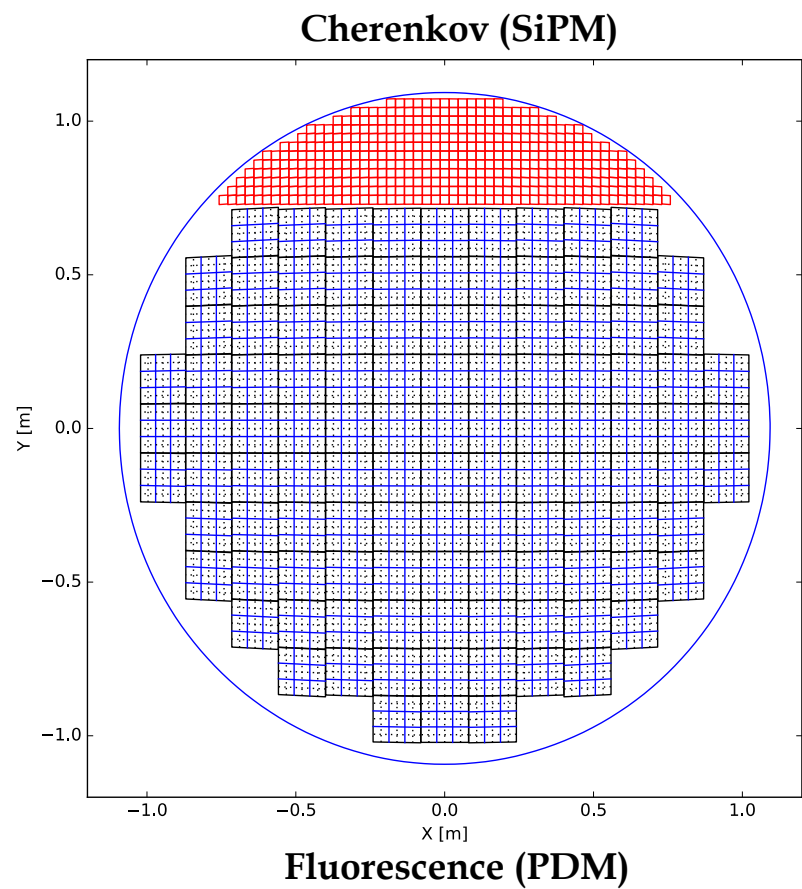
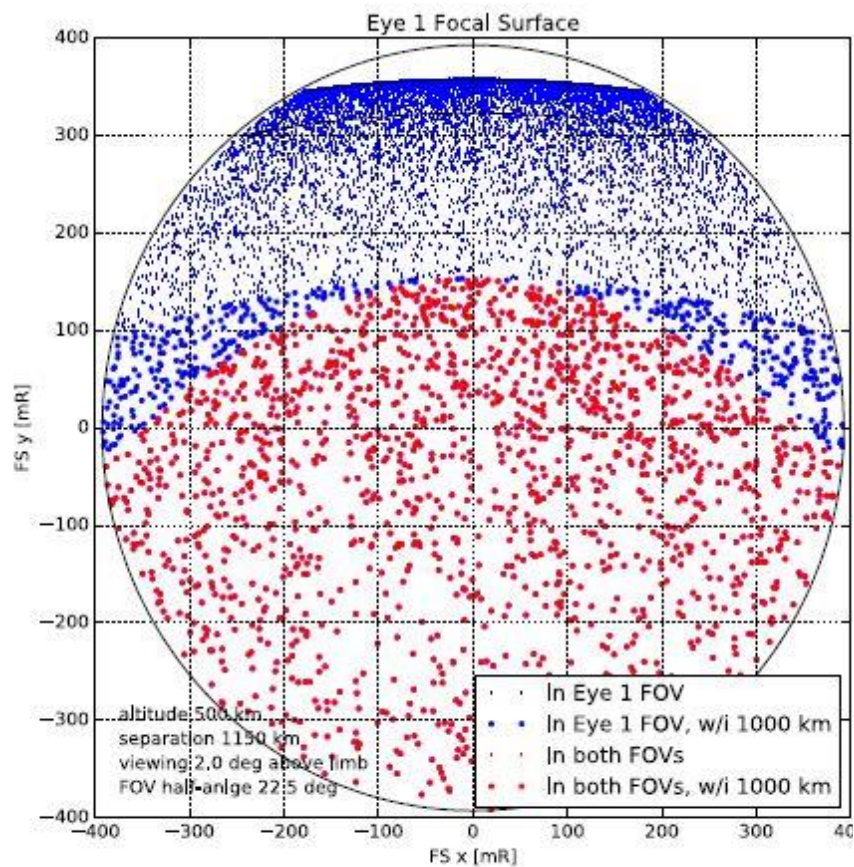


Cherenkov (SiPM)

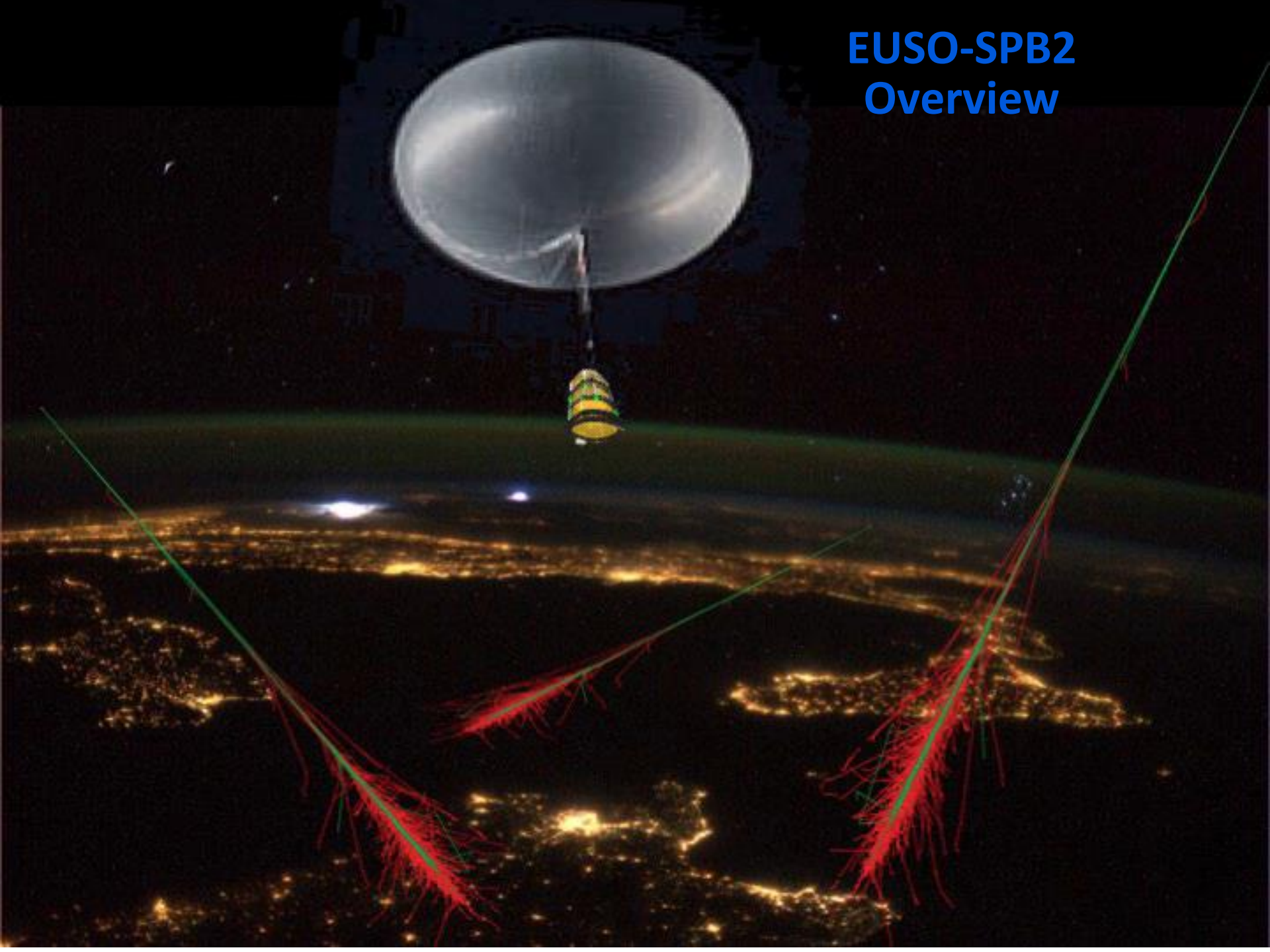


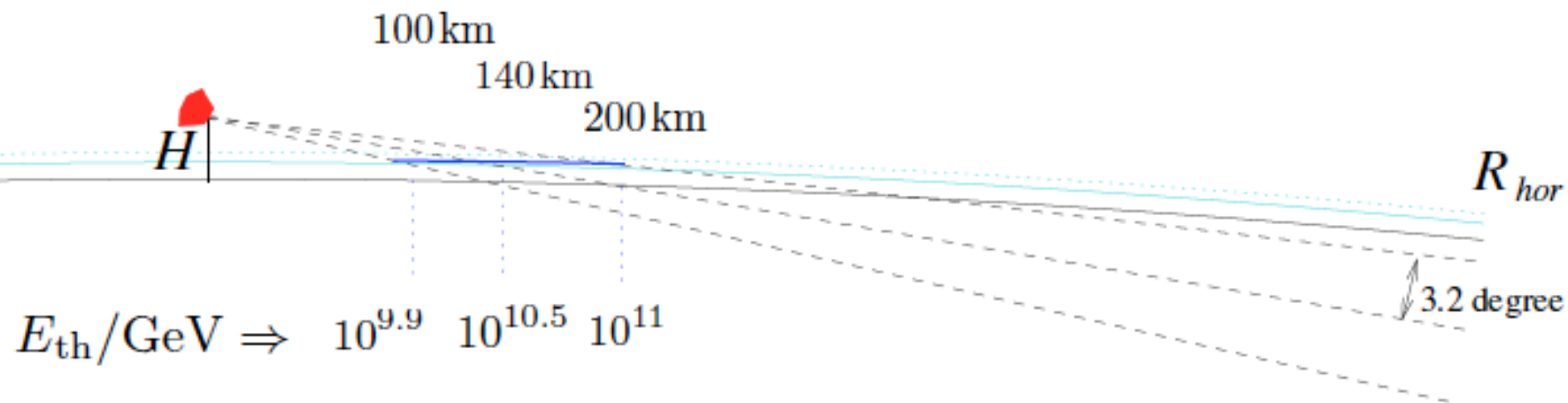
Fluorescence (PDM)

500 km, 1150 km, 2



EUSO-SPB2 Overview





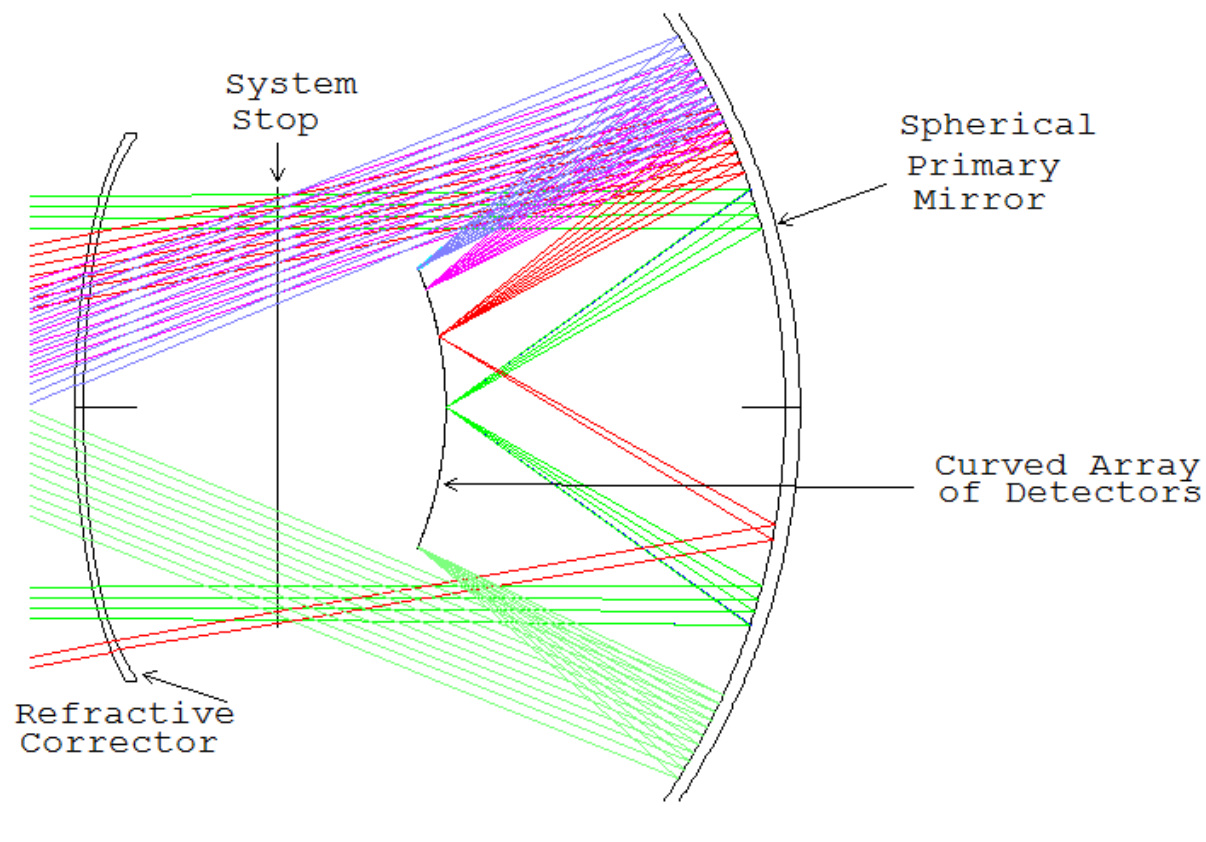
- Detect high altitude UHECR and UHEv through Cherenkov signal
- Pathfinder for POEMMA Instrumentation
 - Schmidt camera: corrector, stop, mirror, coatings
 - Detector technology (MAPMT, SiPM, others), filters
 - Corrector material: PMMA vs glass
 - Charged particle rejection: Veto, Coincidence, Bi-focal
 - Limb field of view
- Background measurement for upward going EAS shower
- Detect EAS showers through fluorescence



EUSO-SPB2 Instrument (as proposed)



- **Optics FoV: 29°x3.2°**
 - Corrector Plate: PMMA $\sim 1\text{m}^2$
 - Image resolution: 1mm
 - Pixel size: 3mm square
 - Mirror: 1.8(H) x 1.1(V) split
- **Detectors**
 - Cherenkov
 - response range: 400 – 700 nm
 - 1st level trigger threshold discriminator (realtime),
 - 2nd level trigger simple logic in FPGA (serial, near realtime)
 - 100 ns signal sampling for 1 us, continuous digitization with 16 channel fifo buffer
 - Fluorescence
 - response range: 330 – 400nm
 - 0th level trigger threshold discriminator (realtime),
 - 1st & 2nd level trigger logic in FPGA (serial, near realtime)
 - 1us signal sampling for 256 us



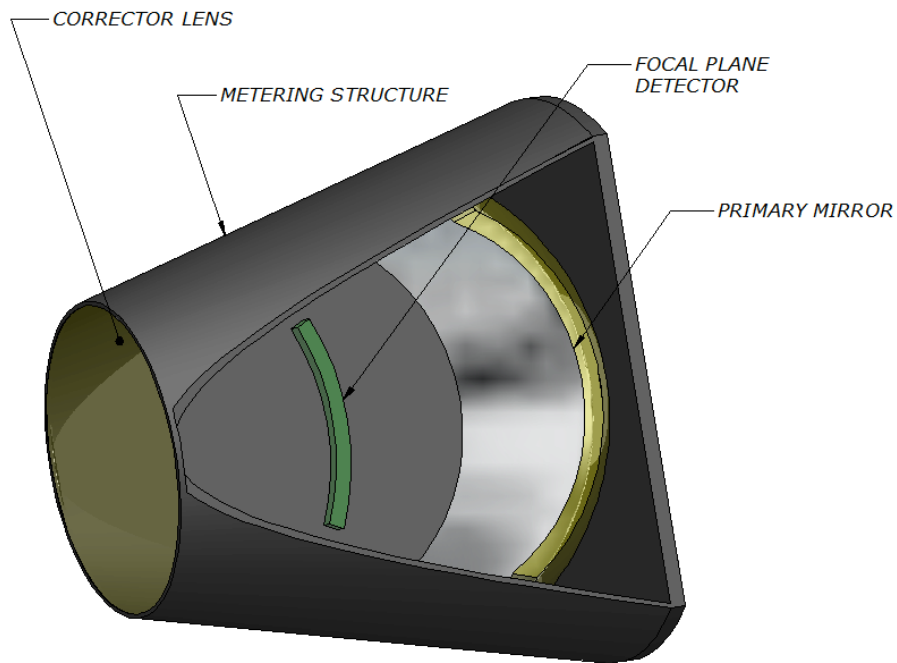
3D Layout

Scale: 0.0667

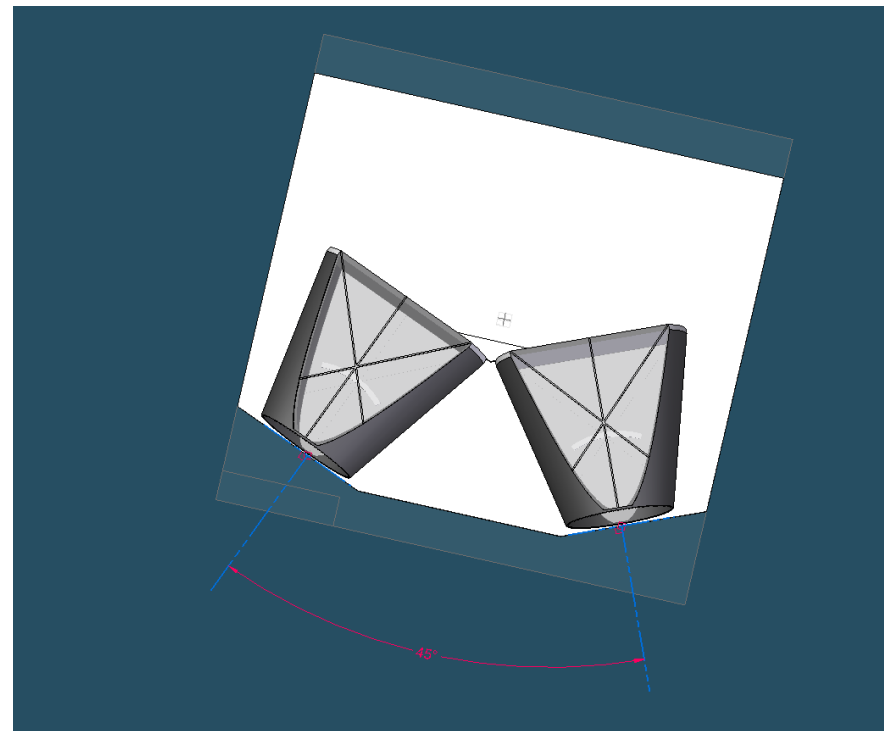
300.00 Millimeters

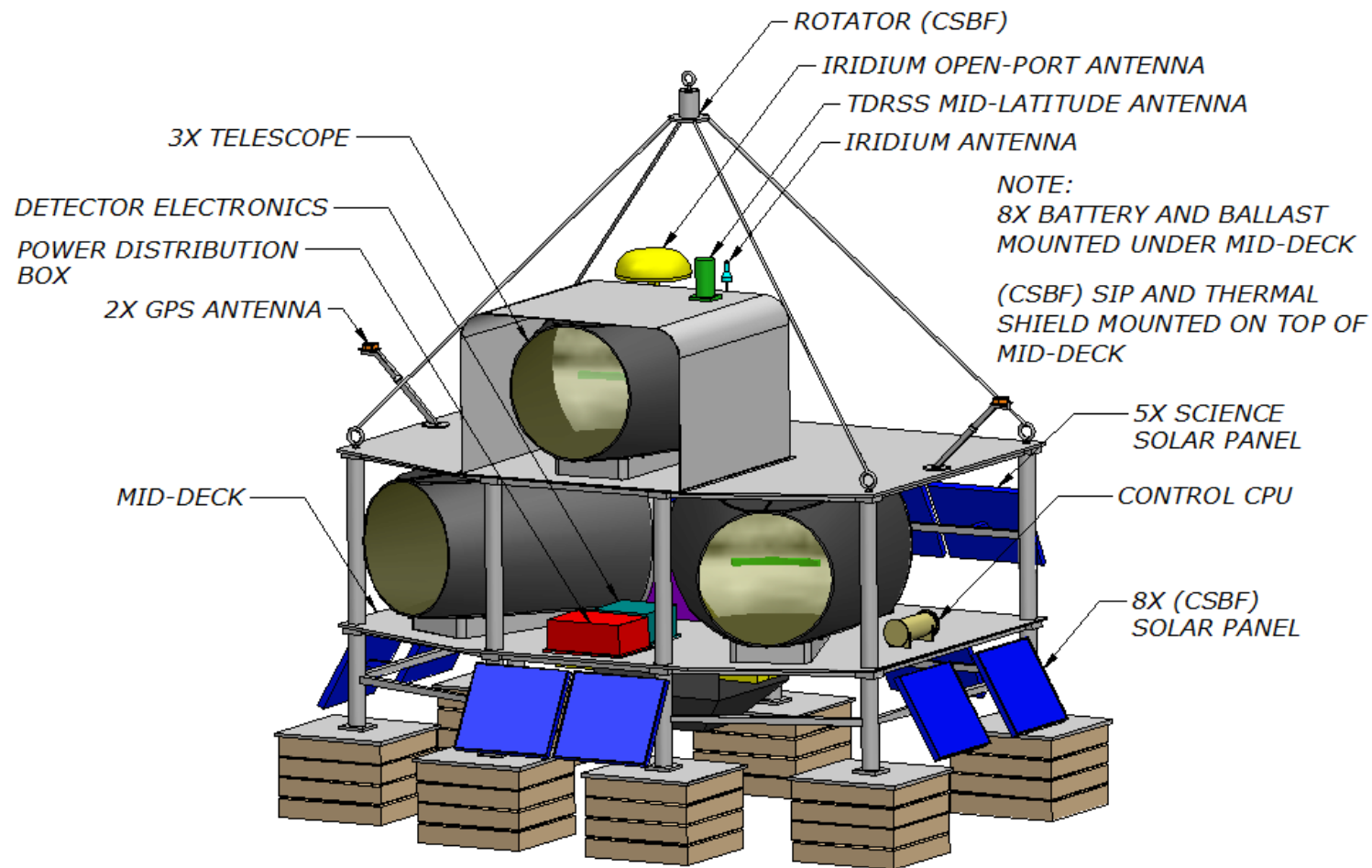
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EUSO-SPB2 Chr.zmx
Configuration 1 of 1



TELESCOPE SECTION VIEW





GONDOLA ASSEMBLY